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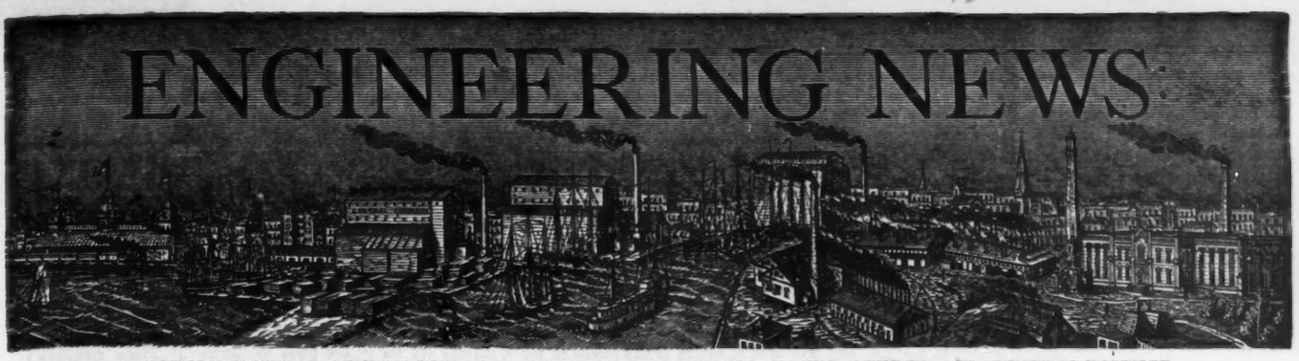
ENGINEERING NEWS



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Certain Improvements in Blast Heating Apparatus.

BY JAMES E. MILLS, B. S.

A paper read before the Engineers' Club of St. Louis, Mo., April 5th, 1876.

The process of reducing iron ores in the blast furnace involves the escape from the furnace of a certain proportion of incompletely oxidized or burned carbon in the form of carbonic oxide gas, even when charcoal or coke or anthracite coal is the fuel used, and in addition to this nearly all the volatile matter of bituminous coal when it is the fuel employed. So incomplete is the combustion in the blast furnace that under very favorable circumstances the amount of heat developed is only about 45 per cent. of the total amount due to complete combustion in the case of coke or anthracite coal or charcoal, and in the case of bituminous coal only about 45 per cent of the amount due to the complete combustion of its fixed carbon. Of the heat developed a portion is carried off as sensible heat in the escaping gases, and only about one-third of the heat which would result from complete combustion of the fuel employed is available within the furnace when the fuel is in the form of fixed carbon, and a much smaller proportion when it is bituminous coal. And it is impracticable to carry the combustion or oxidation of the carbon much farther within the furnace than is now done in the best practice, because the farther oxidation of the carbon would prevent the deoxidation of the iron ore. Consequently the greater part of the calorific effect of the fuel must be obtained, if obtained at all, by burning the escaping gases outside of the furnace, and this method of economizing fuel, though of quite recent date, is almost universally practised.

The heat thus obtained is partly used in raising steam and so converted into power to drive the blast engine and pumps and other machinery of the plant, and a part of it is returned to the furnace in the blast.

The apparatus for conveying the heat of the burning gases to the blast (called hot blast stove) is not without general interest to engineers, for, except apparatus for raising steam, perhaps no means of utilizing heat has been developed through more experimenting, or experimenting on a larger scale, since economy in the use of heat has become an exact science.

The blast passes through the apparatus on its way from the blowing engine to the furnace and consequently under pressure which ranges from 1½ to 5 pounds or even more, to the square inch, The amount of air to be heated, of course varies with the consumption of fuel, but in favorable condition of working of furnace, is from 3.75 to 5 tons, and frequently 6.5 tons or more to the ton of pig iron produced. The temperature to which it is desirable to raise the blast in a well designed, well managed furnace is at least 900° Fah. Sir I. Lowthian Bell, the practical investigator of the causes of consumption, and means of economizing fuel in the blast furnace, considers that in a well designed furnace of proper size there is no gain in raising the temperature of the blast above 500° C or 932° Fah. But in some furnaces at least it has been proved economical to raise it to 1200° or even to 1400° Fah.

In designing blast heating apparatus, therefore, we have to deal with very large volumes of air moving rapidly under pressure, to be heated to very high temperature, with fuel in gaseous state; and to provide against excessive friction and loss of pressure of the blast in passing through the apparatus, and against breakage and wear by expansion and contraction through a wide range of temperature, and oxidation by exposure of hot metal to air, and the warping and fusion and other destructive effects of the high temperature upon the employed materials in construction.

The various kinds of apparatus employed for accomplishing the work may be grouped in two classes. In one of these, the gases while burning, or after being burned, while still retaining the heat of combustion, are passed over masses of fire brick which serve to catch and store up the heat within themselves until they have reached the proper temperature, when the hot gases are turned off, and the blast is driven over them and takes from them the required heat. To make the process constant there are two at least of such masses of fire brick through which the burning gases and blast are alternately passed. As a structure of fire brick cannot be made to be air tight under the pressure and at the temperature produced, the masses are enclosed with a casing of plate iron Such an enclosed mass of fire brick, with its channels for admission, passage, and exit of gases and air, and its inlet and outlet pipes, and its valve for regulating the flow and changing the course of the gases and air, in its most developed form, is the Whitwell stove.

In the apparatus of the other class, the air is passed continuously through iron pipes, on the outside of which the gases are burning, and consequently receives its heat through the iron wall of the pipes. The pipes are arranged in an enclosed chamber, and the gases are burned in the same chamber or in a combustion chamber beneath it. As the blast is enclosed in pipes, the fire brick walls of the chamber or stove do not require an iron casing.

The quantity of gaseous fuel escaping from the furnace is so large that the amount of heat which can be imparted to the blast is limited by the ability of the material employed in the construction of the stove, pipes, valves, etc,, in which the blast is heated and conveyed to the furnace, to withstand the high temperature, The fire brick apparatus can of course bear much greater degrees of heat than any system of iron pipes, and consequently in the stove of the Whitwell type the blast can be raised to a much higher temperature than in the other class. The disadvantages of stoves of this class are large first cost, considerable complication of parts, and great care required in the management of them.

The stoves with iron pipes have been much the larger in use, and on account of their comparatively small first cost and simplicity will probably continue to be used quite generally, at least at charcoal blast furnaces ; and it is an object of importance to improve the stoves of this general type to the highest practicable degree of efficiency and durability.

They have gradually developed into rectangular brick chambers with the iron pipes conveying the blast arranged in straight rows lengthwise or crosswise of the chamber, and the gases rising through long narrow slits in the floor between the rows of pipes. The gases are either burned in the spaces between the rows of pipes or in a separate chamber below the one containing the pipes from which they pass up through the slits in the floor to the spaces between the rows of pipes.

There are two kinds of pipes in each stove ; one kind called bed pipes consist of rectangular boxes, usually divided by a partition running lengthwise, into two parts. These lie horizontally on the floor of the chamber. The other kind are of circular or elliptical cross sections, and stand vertically upon the bed pipes and open downwards into them. They are also either divided into two parts by a diaphragm extending from the bottom to near the top of the pipe, as in the so called pistol pipe, or are doubled upon themselves as in the so called syphon pipe. In the case of the pistol pipe, the diaphragm rests on the partition of the bed-pipe or a projection of it, and one apartment of it opens downward into one apartment of the bed pipe, and the other apartment of the vertical pipe into the other apartment of the bed pipe ; and in the case of the syphon pipe one limb opens into the bed pipe on one side of its partition wall and one on the other side. The blast enters the bed pipe on one side of its partition wall, and passes up through an apartment or one limb of a certain number of vertical pipes, and down through the other apartment or other limb of the same pipes to the bed pipe on the other side of its partition wall, thence by a horizontal connecting pipe to another bed pipe to pass through it and its vertical pipes in the same way, and so on to the oulet pipe. There are many modifications of this general arrangement, but the essential features of the apparatus as I have presented them are common to all the best stoves of the class in general use.

There are serious avoidable defects in this general plan of stoves, which add to the first cost, and give rise to unnecessary wear of the pipes by oxidation and bending and cracking and also unnecessary strain upon the walls and whenever the temperature of blast sustained by one of these stoves is near the point of safe endurance of iron, the destruction of pipes and of walls is a source of very considerable expense, and frequently of delay.

The rectangular form of the chamber gives rise to uneven reception and radiation of heat and consequent uneven expansion and contraction of the walls, and renders necessary very strong binding with iron rods and angle-rods, and this does not generally prevent considerable bulging and cracking. The arrangement of pipes in rows parallel to two sides of the chamber leaves two interspaces in each chamber bounded on one side by a wall and on the other by a row of pipes, and the flame in each of these two interspaces presents one broad side to a wall, and radiates heat directly to it, or, as is usually the case, the flame is omitted from these two interspaces and one side of two rows of pipes is without heat directly radiated from the flame. When the gases are burned in a combustion chamber, one side of two rows of pipes is out of the direct course of the hot gases, or the inner surface of two walls are in that course. Again by the usual arrangement, or any convenient arrangement with parallel rows of pipes, one side or end of the chamber must be hotter than the other.

About two years ago it became necessary for me to plan a hot blast stove for a charcoal furnace to be built for the Midland Blast Furnace Co., and I had an opportunity to put into practice an arrangement which I arrived at in the endeavor to avoid the defects of the common plans, and secure the best practicable result from a stove of the class. The stove was built and has been well tested, and the results of trial have proven the advantages of a plan which is theoretically—I think you will agree with me—better than those described; and to this I invite your more particular attention.

The stove proper has a cylindrical vertical wall and a hemispherical roof or dome, like some potters kilns. The exposed surface and consequent loss of heat by radiation and convection are therefore the least practicable and so also is the amount of material in the wall. The absorption and loss of heat are very even throughout the wall, and consequently the different parts of it expand and contract evenly. The cylindrical form also reduces the necessary binders to simple hoops of sheet iron.

The pipes through which the blast passes are placed in

rows arranged radially from near the center to near the circumference of the chamber; and the gases which serve for fuel are admitted through the radial slits, one in each section of the floor, and burned in the spaces between the rows of pipes. Therefore each sheet of flame presents both broad sides to rows of pipes, one on each side, and each row of pipes receives heat directly radiated from flames on both sides of it. There are six such rows of pipes, and consequently six interspaces and six sheets of flame in the stove actually built.

The blast coming from the engine enters a drum near the roof and passes from it by six pipes extending outward and downward near the roof and wall of the chamber to the outer end of each of the six rows of pipes, and thence passes through the six rows to a drum in the middle a little lower than the drum before mentioned, and thence by an outlet pipe towards the furnace. The slits admitting gas through the floor approach one another as they approach the center, and consequently the proportion of flame to space increases toward the center as far as to the inner ends of the slits. To insure complete combustion, there is a chimney rising from the middle of the dome. The air for combustion is admitted through the outer wall at the level of the floor by an opening opposite the end of each of the slits which admit gas. The tendency of the hot gases and flame is towards the middle of the stove. The blast therefore travels in six streams toward the hottest place in the stove until it reaches the outlet pipe.

The nearness of the drum and pipes which first receive the blast, to the roof and outer wall, combines with the direction in which the blast travels, and the position of the flame. and the direction of the draught to keep the outer parts of the chamber cool, and to reduce to the minimum the loss of heat through the walls, and the destructive effects of heat upon them.

I will now describe more in detail the stove which was built on this plan and which is represented by the accompanying drawings.

The inside diameter of the cylindrical building is 18′ 6″, and the radius of the dome 9′ 3″. The height from the floor to the edge of the dome is 12′ 4″ and to the center of the dome 21′ 7″.

The foundation consists of a wall of sandstone rubble 2 feet high and 18 inches thick.

The vertical wall is of fire brick 13½″ thick, except the upper one foot which is 18″ thick, projecting outward 4½″. The dome, which is also of fire brick, is 9″ thick. It rests on the inner 9″ of the vertical wall. Outside of it on the vertical wall and flush with the outer surface of the lafter, are laid 13 courses of red brick, thus containing the vertical surface of the wall on the outside about 31″ higher than the lower edge of the dome, and encircling the lower part of the dome to that height.

The wall is bound by three hoops of plate iron three-sixteenths by four inches, one at the upper edge of the vertical outer surface of the wall, one at the level of the lower edge of the dome, and one 8″ from the ground.

There are six small arched doorways in the vertical wall at equal distances from one another, opening into the chamber midway of the outer side of the interspaces between the rows of pipes. They rise from the floor of the chamber and are 4″ high to the crown of the arched upper end, and 15″ wide below the spring of the arch on the inner side, widening outward as much as due to radial position of the sides. The doors are simple plates of fire brick or tiles, bound around the edge with a wrought iron band, to be opened and closed by being raised and lowered by pullies. To afford a sloping surface for the doors to rest and move upon, the joints of the doorway and a portion of the wall above, are made to project, beginning at a point twice the height of the doorway or 8′ above the ground and increasing downward so that the projection at the ground is 9″. By this arrangement iron doors exposed to flame are avoided and moreover the opening for admitting air being made by raising the door, is at the bottom of the chamber. These doors have not yet been put on, but instead. the doorways were filled in with fire brick, leaving only small openings at the bottom to admit air.

On both sides of each doorway is a peep-hole of the size to be closed by a brick placed in endwise.

The doorways are large enough to admit the passage of the pipes and bed pipes but not of the drums. For admitting these a portion of the wall is arched over so that it could easily be taken out and replaced.

The flue for admitting the gas passes around under the floor and is annular, and its middle line makes a circle 12′ in diameter about a centre directly under the centre of the chamber. It has a branch opening into it from the furnace. Where it passes under the walls of the building or the foundation stones upon which the pipes stand, it is arched over, and its cross section is 18″ wide up to the spring of the arch, and 1′ high to the spring and 1′ 9″ to the crown of the arch, but under the interspaces between the rows of pipes, its walls continue vertical to the top, and it is covered over with burnt tiles excepting a slit 3′ long nearly in the direction of the radii of the chamber, and 3″ wide. To obtain the length of 3 feet the slit is extended by a groove out into the wall of the flue on either side. The slit can be narrowed and shortened at will by bricks placed on top of the tiles and moved from outside through the door by a rod. The wall of the flue is 12″ thick. The tiles covering the flue on each side of the slit can be raised, and through the openings thus made a man can reach the ashes and dust in the flue with a hoe and move them toward the branch that comes from the furnace, and from the branch they can be easily raised outside of the stove. To facilitate the removal of the dust and ashes and render it practicable while the stove was hot, or comparatively so, three openings were made to the flue from outside, but they were not used or needed, because, on account of the proportion of the area of cross section of the flue to the volume of gas moving through it, the dust and ashes did not accumulate in quantity to materially hinder the flow of the gas.

The foundations upon which the pipes stand consist of six stones, one under each row of pipes, placed radially like the rows of pipes, and extending from within two or three inches of the wall of the chamber to within one foot of the centre. They are about 8′ long, 1′ deep and 2′ 3″ wide, except at the inner end where one vertical edge is truncated and the stone narrowed to fit the space for it. The material of the stones is sandstone.

A wall of fire brick 4½″ thick is carried up from the floor by the sides of these stones between them and the spaces where the gases are burning, and still higher by the sides of the bed-pipe and the sleeves at the foot of the upright pipes, to a height in all of about three feet, These walls, with the outer walls of the chamber enclose on the sides, the lower part of the spaces between the rows of pipes where the gases and air enter and meet, but they are all open above, and the free radiation of heat from the flame to the pipe is but slightly obstructed. The chimney rises 40 feet above the dome, is of sheet iron (No. 14) and is lined with 3 ins. thick of fire brick from the dome to a height of 10′. Its diameter within the lining is 3′, and above the lining 3′ 6″, till within 2′ 6″ of the top where it narrows so that the diameter at the top is 2′ 6″, There is a damper attached at the top, and for two lengths of sheets (about 5′) below it the iron is three-sixteenths inches thick. There is a guy band 12′ from the top. The weight of the chimney does not rest on the dome but is transferred to the upper edge of the vertical wall by three pieces of rail road rails which serve as a tripod. Their outer and lower ends rest on cast iron feet lying on the vertical wall. At their inner and upper ends they are attached to the chimney at a point 8′ 6″ above its lower end. Here also is a sheet of iron three-sixteenth inches thick and a wrought iron band 6″x½″, and the rivets pass through the flanges of the rails and the band and iron of the chimney. The rails are stiffened and held in place by rods of ¾″ round iron enclosed in 1¼″ gas pipe, and extending from midway between the two ends of each rail to the lower end of of the chimney. This end of the chimney is stiflened by a wrought iron band 4″x½″ on the outside, and a piece of 2″ angle iron on the inside, the latter serving to hold up the brick lining.

The pipe which conveye the blast from the engine to the apparatus is of wrought iron ⅜″ thick, 16″ in diameter and opens downward into the top of the drum from which the blast is distributed to the six rows of pipes This drum is of wrought iron, and is 2′ 10″ in diameter and 1′ 3″ long or high. It is situated directly under the centre of the dome, and its lowest surface is 14′ 9½″ above the floor of the chamber. It has besides the openings for inlet and outlet of blast, three small man-holes closed with small man-heads, large enough to admit the hand and arm. Around the periphery of the drum are six cast iron thimbles to which are attached by flanges and bolts the pipes which take the blast to the ends of the rows of pipes. These also are of wrought iron ⅜″ thick, and are 7½″ in diameter inside measurement, except at the lower end where they are enlarged to lap down over the upper part of the short pipes or thimbles projecting upward from the bed pipes. The joint at this connection is rendered tight by a sleeve 1′ long, and rust packing.

The remaining pipes (syphon and straight pipes and bed-pipes) and the sleeves and the drum which receives the blast from the six rows of pipes, and the outlet pipes are all of cast iron ¾″ thick.

The bed-pipes consist of rectangular boxes 21½″ long, 10½″ wide and 6″ high—all inside measurements—with two short pipes or thimbles of same cross section as that of the syphon pipes projecting 4″ upward from one of the broadsides and open at the outer or upper ends. The boxes lie on the opposite broadside, and are placed in six sets of radial rows, each set consisting of seven boxes in two rows, one of four and the other of three boxes. The two rows are so placed side by side that one thimble of each box in the shorter row is abreast one of a box in the longer row, and the other thimble is abreast one in the next box of the longer row. The two rows are separated by a space 1¾″ wide, and the boxes in each row by a space 1″ wide. At each end of the long row is a thimble not paired with one in the shorter row. To the one at the outer end is connected the wrought iron pipe which brings the blast to the row, and the one at the inner end opens into the straight vertical pipe which takes the blast to the drum which receives it from all the six sets of rows. On the six intervening pairs of thimbles stand the syphon pipes. One limb of each syphon stands on a thimble of one row and one on a thimble of the other row, and by the arrangement of the boxes or bed-pipes, each bed-pipe in the short row receives air from one in the long row through one syphon, and delivers it through another syphon to another box farther on in that row, and so the blast passes from row to row and forward till it reaches the last box of the long row and passes from it through the straight vertical pipe to the drum which delivers it to the outlet pipe leading toward the furnace.

We have called the rows radial. The middle line of the long row of boxes or bed-pipes is exactly radial; of course the other row is not exactly radial and the divisions of the floor of the chamber between the sets of rows are not exactly true sections of the circle. The slit for the admission of gas is placed midway between a short row of pipes on one side and a long row on the other, and each door is opposite a slit.

The syphons have an elliptical cross section with diameters 6½″ and 7¾″, inside measurement. The centers of the two ends are 14¾″ apart, and the pipes are so doubled upon themselves as to bring the long diameters of the two limbs into line, It is 11′ 3¼″ from the lower ends to the top of the curves of the outside of the pipe at the junction of the two limbs.

The straight vertical pipes at the inner end of the rows have the same cross sections and are 11′ long,

The drum which receives the blast from the six rows of pipes and delivers it toward the furnace through the outlet pipe, is a cylinder 3′ 10½″ in diameter and 1′ long or high—inside measurement—with a pipe or thimble 1′ in diameter (inside) and 4″ long, projecting from the periphery, which connects with the outlet pipe, and six pipes of same cross section as the vertical straight pipes, and two feet long projecting from the lower end. These pipes rest on, and open into, the six upright pipes. The centres of their inner ends are each 1′ 7″ from the centre of the bottom of the drum, and a line connecting them would form a hexagon with sides of 1′ 7″.

The outlet pipe is 1′ in diameter inside measurement.

The connections of the different castings are all made with sleeves and rust packing, the space between the sleeves and the pipes filled with packing being ½″ wide The sleeves therefore have a diameter 1″ greater than the outside diameter of the enclosed pipes. A part of the sleeves are 8″ and a part of them 12″ long. I would now make them all of the latter length so that the packing might extend 6″ either way from the joint, and for this purpose would make the thimbles on the bed pipes and the one on the drum 6″ instead of 4″ long.

The amount of material in the whole apparatus is as follows:

Principal castings (by actual weighing:)

42 bed-pipes (average weight 228.88 lbs.).. 9613 lbs
36 syphons (average weight 1546.17 lbs.)..55662 "
6 straight vertical pipes (average weight

703.5 lbs.)	4219 "
90 sleeves, 62-9° long, (average weight 64.9 lbs.)	4024 "
90 sleeves, 28-12° long, (average weight 85.9 lbs.)	2405 "
1 drum	2053 "
1 outlet pipe*	955 "
1 sleeve to latter	184 "
Total	79115 lbs.

Or $35\frac{715}{2240}$ tons, essentially 35⅓ tons.

Wrought iron pipes and drum and inlet pipet together with the small cast iron man heads and thimbles and flanges about	2200 lbs.
Wrought iron of the chimney including cast iron damper (by actual weighing)	2382 lbs.
Three pieces of rail forming the tripod of chimney about	850 lbs.
The ¾" round iron and 1¼" gas pipe serving as braces to the tripod	123 lbs.
The castings on which the rails of the tripod rests about	253 lbs.
The wrought iron about doors and attachments about	400 lbs.
Cast iron pullies to doors about	300 lbs.
The three draw bands or hoops encircling the wall of the building (by actual weighing).	1060 lbs.
The fire brick work in the building including as much of the flue as is under the building, all tiles, lining of chimneys, etc., about 1,315 cubic feet, or calling the cubic foot 20 bricks	26300 bricks
The red brick, 150 cubic feet or	3000 bricks
Stone in the foundation of the wall of the building	206¼ cu. ft.
The six foundation stones of the rows of pipes	123 cu. ft.

The service thus far actually performed by this apparatus is as follows:

The furnace to which it was attached was in blast 137 days, After the first three days the blast was maintained very steadily at 900° Fah. to the end of the campaign, or 134 days. The amount of air or blast heated to this temperature averaged during the time 2723 cubic feet per minute and for a considerable portion of the time was over 3000 feet. The reports based on the number of revolutions and size of the blast engine make the amount of blast very much larger but to avoid all error by leakage of pipes and other causes, I have given the amount received by the furnace calculated on the basis of fuel consumed and probable composition of gaseous products of combustion.

The Superintendent—Mr. Wm. E. Rowell—informs me that in arriving at the temperature of the blast he carefully checked the readings of the gauge by means of the fusing point of alloys.

The building proper shows no harmful effects of heat The wrought iron pipes and drum are also, I believe, as good as when put in. No one of the cast iron pipes or bed pipes is cracked or burned through, nor is the drum. One or more of the six upright pipes are somewhat bent, from the weight of the drum and outlet pipe bearing upon them while hot, and I would in future take this weight off by a small fire brick pillar rising to the drum from the centre of the floor of the chamber. Some of the joints leaked on account of defective packing. The pipes and flues were not cleaned during the campaign.

The apparatus performed all that was required of it for the furnace to which it was attached, without at any time being forced to the limit of its capacity or endurance, and yet I think all who are familiar with the subject will agree with me that the performance recorded is unusually large, considering the size of the stove and the amount of material used in its construction; and that it withstood the effects of the high temperature maintained during the campaign with unusually slight wear or destruction of parts.

Operations were begun at St. George, N. B., on the 8th instant, upon the Great Southern Railway, and the first sod was turned in the presence of the president, directors and a number of the company, a salute being fired from Fort Douglas. Between 30 and 40 miles of the road have been sub-let, and the work has begun on a portion of the line.

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*The part of the outlet pipe extending from the drum to the outside of the building.

†So much of it as is within the stove.

The American Society of Civil Engineers.

An exposition of the progress and present condition of Engineering in America will be made at the Centennial Exhibition in Philadelphia, under the auspices of the Centennial Commission of the American Society of Civil Engineers, No 4 East Twenty-Third St., New York City.

Sub-committees have been formed to present, in proper form, the various branches of Engineering.

THEODORE G. ELLIS, Chairman,

JOHN BOGART, Resident Secretary.

SUB-COMMITTEE ON WATER WORKS.

The subject of American Water Works, for the supply of cities and towns, will be illustrated by an historical and descriptive memoir and drawings, photographs and models of important or peculiar structures. To aid in the preparation of such memoir, and the presentation of the subject fully, you are requested to furnish the undersigned, as soon as practicable, with such information on the following points as you are able to give, relating to the works with which you are connected:

1. When were the works constructed? Names of engineers by whom designed and built.
2. Under what organization were the works built?
3. Under what organization are they managed?
4. What is the source of supply, and the area and topographical and geological character of its water shed?
5. What is the annual rain fall on the water shed? Send tables of same for several years, if practicable.
6. Have you tested the discharge from streams? If so, with what results?
7. Quality of water; analyses made of it.
8. Cost of works; original and additions.
9. Cost of maintenance of works; annual.
10. Population of town and number of consumers, and quantity of water used.
11. Character of supply; gravity, steam pumping or water power.
12. If by gravity; size, form and grade of conduit.
13. If by pumping; description, capacity, duty of machines. A skeleton sectional elevation of engine and pump, on scale of one-twelfth or one-twenty-fourth, is particularly requested. Indicator card from pump and from engine. Lift of water.
14. Reservoirs; size, method of construction.
15. Distribution; kind, size and length of pipes. Durability of pipes, mode of protection against corrosion and incrustation. Formula used for thickness of pipes. Notes on leaks and on loss of head.
16. Gates, stop-cocks, hydrants; kind and number. Comparative economy and efficiency of varieties used.
17. Meters; kind and number used; correctness and durability.
18. Have you made experiments on flow in pipes and conduits? If so, please give results.
19. Have you used filter beds or galleries? If so, with what result?
20. Note any special difficulties in construction, and method of overcoming them.
21. Failures of structures, and probable reasons for same.
22. Copies of reports and documents embodying valuable information, are particularly requested.
23. *Drawings and photographs of important structures, and of any peculiarities of detail in works; sections of dams and embankments and conduits, and plans of gate houses and engine houses are requested for exhibition.* They will be carefully preserved, and returned after the Exhibition, if desired.
24. You are requested to conform your replies to the above classification, to write on "foolscap," or "legal cap," paper, and only on one side of the sheet.

Any information on points of interest, not included in the above list, will be thankfully received.

25. Do you wish to exhibit models of any machines or structures?

Address, J. JAMES R. CROES, C. E.,
Chairman of Sub-committee on Water Works.

A Call for Fair Play.

The American love for fair play, about which considerable has been said of late, has an excellent opportunity to display itself in the case of James B. Eads, now engaged in improving the mouth of the Mississippi. The work on which Mr. Eads is engaged has been often referred to in these columns, and has excited more or less comment all over the country during its progress, and especially in the last few weeks, when success has so far crowned his efforts that vessels drawing seventeen feet of water have gone through the South Pass, heretofore impassible to craft drawing more than eight or nine feet. The importance of this work and the immense benefit which the country will reap from its successful performance are conceded on every hand; and it would seem, therefore, as though every possible encouragement should be given Mr. Eads, especially as he is doing the work at his own risk, the terms of the contract with the government postponing all payment to the successful completion of the work. Such encouragemnnt he has received from every quarter but one—the Engineer Corps of the United States army. For some reason this corps, and especially its chief, General Humphreys, has regarded Eads' work from the first with undisguised hostility. What the reason is, is not at all clear It is true that General Humphreys has no faith in Mr. Eads' theory, and disagrees entirely with that gentleman as to the adaptability of the "jetty" system to the purpose of deepening the channel of the Mississippi. The General has shown to his own satisfaction and to that of his colleagues that it is impossible the jetty system should do what Mr. Eads is confident it can and will do. To his opinion on the subject the General is undoubtedly entitled, but his holding such an opinion is no sufficient explanation of his opposition to Eads or of his efforts to embarrass the latter in carrying out his work. If he is honest in his opinion and has any pride in it, the wise course for him to pursue would seem to be to permit Eads to go on with his work and vindicate by his failure the soundness of that opinion. To obstruct or hinder the work in any way is to throw a doubt upon that soundness; for in the absence of any authoritative arbiter between the General and Mr. Eads, the public will be quite as likely to indorse the latter's views as the former's, and will be still more likely to give such indorsement if it can be shown with any degree of certainty that the failure to demonstrate Eads' theories is due to Humphreys' interference. In other words, if the opposition of Humphreys should stop the improvement short of completion it would always be open to Eads to assert that but for that opposition his plan would have been a success; while the General will be remitted to his simple platform of disbelief in the plan, weakened by the suspicion that he feared its success.

It may not be clear at first glance how the mere disbelief of the Engineer Corps in Mr. Eads' theory—no matter how openly avowed—can affect the success of Mr. Eads' work; but when it is considered that the work is carried on with capital furnished Mr. Eads upon faith in his theory, it is perfectly clear. Capital is timid; and the Engineer Corps is a body whose collective opinion, expressed through its Chief would naturally have some weight in a matter coming within the range of its professional knowledge. That it had such weight in the beginning is a part of the history of Mr Eads' enterprise; and the fact that he was able in the face of this weighty opposing opinion to obtain the capital necessary for applying his theory, is one of the strongest testimonials possible to his confidence in that theory and his ability to inspire others therewith.

It seems almost incredible that with such important results attained as have been, and with the prospect so flattering for complete success, this opposition on the part of the Engineer Corps should continue; but the facts are too strong to admit of any doubt. Within a very short time Mr. Eads has been compelled to ask the Secretary of War to restrain a Major of Engineers, engaged upon some public works near New Orleans, from spreading reports injurious to him and calculated to embarrass him very much in completing his contract. He has been compelled to ask also, that the result of the official examination of his work be communicated to him, instead of being kept back, for no other apparent reason than to gratify the jealousy of the Engineer Corps. He has been compelled, in short, to ask for fair play, and it is to be hoped that there will be a sufficient sense of what is right and just in the War Department to give it to him. Neither the department nor the government it represents can afford to allow, much less to sanction, the delaying of this work by an interference which is so evidently due to jealousy and to a willingness that a very valuable improvement shall be lost rather than an engineer be shown in the wrong. The only fair, straightforward course for the Chief of the Engineer Corps and his subordinates is, as we suggested before, to give Mr. Eads every possible chance. If he fails, then the Chief's opinion will be all the more triumphantly vindicated; and if he succeeds, the Chief ought to be among the first to congratulate him upon performing a task against which science herself seemed to be arrayed. And if the Chief and his subordinates will not pursue this course of their own volition, the public will warmly commend the War Department for whatever it may do in preventing their pursuit of a contrary course.—*The Detroit Free Press.*

ENGINEERING NEWS.

SATURDAY, JUNE 17th, 1876.

GEO. H. FROST, - Editor and Publisher.

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HOUSEHOLD DRAINAGE.

Sanitary engineering is becoming of more importance in the public eye from year to year, and is absorbing some of the best talent in the profession. More and more diseases are found to arise from, and to be promoted by, an unwholesome state of the accessories of our dwellings. It is therefore the duty of the city officials, not only to remove such nuisances when found to exist, but to take measures to prevent them from arising; a careful attention to drainage and ventilation will secure both of these objects, and they come within the scope of the engineer and architect. The existence of numerous boards of health in all our large cities, as well as the state organizations, show how universally intelligent people are aware that a large proportion of the diseases to which the inhabitants of cities fall a prey are preventable by a proper care for surroundings.

We have been interested in reading a statement of some of the investigations of the Boston Board of Health during the past five months, in regard to the causes of diphtheria, pneumonia, croup and typhoid fever, diseases which attracted the attention of the Board last year by their noticable increase. It is stated that between 400 and 500 cases have been thoroughly examined, with the result that some 300 pronounced nuisances have been discovered, and that the fact of a connection between filthy conditions and the diseases under inquiry has been proved beyond a doubt. "That typhoid fever is a filth disease has long been known ; but that diphtheria could be so classified was not so certain. The influence of filth in the production or aggravation of pneumonia and croup, though not so easy of proof as in diphtheria and typhoid fever, seems, as before said, to have been established. The fact that the Inspector failed to find filth-causes in a large percentage of cases merely shows that the diseases must have been the result of contagion." To the Inspector was handed each morning slips concontaining the name and residence of every person dying of these diseases within the city limits. The inspection of each dwelling-house was necessarily a duty which required much time and which was not always welcome to the occupants.

The construction of the drainage is often left by the builders to stupid and ignorant mechanics. The most common defect discovered was faulty connection, or no connection at all, between waste-pipes and drains. Sometimes odors and sewer-gas escape, to permeate the house; sometimes the waste water leaks out, and sometimes the solid contents themselves have effected a lodgment and accumulated to an incredible extent. Cellar drains are sometimes found open throughout a portion or all of their course; at other places the masons have failed to cement around the place of junction ; open mouths to cess-pools will be found in back-yards, where children play and where the foul odors can enter the house. In one remarkable case which we have heard of in another city, the external opening of the air-box of the furnace was directly over the mouth of a cess-pool, and, after several cases of sickness, the owner called in an architect who discovered that he had been drawing into his furnace the foul sewer-gas, warming it and spreading it over his house.

It may happen that the slight settlement of the foundations of a new house, especially if it is upon made land, will fracture the drain pipe just outside of the wall. The infiltration of the sink water into the soil outside will not cause a nuisance as soon as the defects within the house, but it will have its effect upon the health sooner or later. The tardy action in such cases renders the cause unsuspected. The percolation of water which is detrimental to health, into wells is another cause of sickness which is as undoubtedly proved as any we have before mentioned. Board of Health reports are full of citations of such examples. The whole arrangement of the drainage and ventilation of our dwelling-houses and neighborhood should be the subject of intelligent and careful forethought.

TO CHIEF ENGINEERS AND SUPERINTENDENTS OF WATER WORKS.

There are between 300 and 400 cities and towns in the United States which have a public water supply. The Centennial Commission of the American Society of Civil Engineers wishes to make as full an exposition as possible of the progress and present condition of Engineering in America, and as the Department of Water Supply is one of the most important in the profession it should be very thoroughly represented at the Exhibition. But in this, as in other matters, it is very difficult to obtain information from the parties who alone are competent to give it, and so in response to the numerous circulars which have been sent out by the Committee on Water Works, comparatively few responses have been made. We print to-day a circular containing a list of questions addressed to the Chief Engineers and Superintendents of Water Works, and we hope that these latter will cordially and promptly respond to the best of their ability. It is by the wholesale collection of these statistics and the careful collation of them by competent men, that generalizations are to be obtained, which will be of value to the whole profession, and through them to the public whom they serve. Let there then be throughout the Engineering profession of America a cordial and hearty unanimity in co-operating with the Society which has taken upon itself the great bulk of the labor and expense of the Engineering exhibit at Philadelphia this year.

RAPID Transit has been further extended in London by the completion and opening for public traffic, on April 5, of the East London Railway, which is another of those gigantic underground enterprises for which the metropolis of England is so distinguished. The most remarkable feature of this new work is the fact that a considerable portion of the line is to be built under water. The tunnel extends southeasterly from the Liverpool-street station of the Great Eastern Railway, passing directly under the warehouses and water basin of the London docks, thence under the embankment, under and across the Thames River, to the New Cross station of the Southeastern Railway, thus connecting all the roads named, and also the London and Brighton and South London lines. At Shadwell and Whitechapel, magnificent stations, each 250 feet in length, have been erected. The total cost of this new line, which is a little less than six miles in length, has been £3,000,000, or $16,000,000. That portion of the line under the Thames passes through the old Thames tunnel, built by the celebrated engineer, M. I. Brunel. This work was commenced in 1824, and opened for foot passengers in 1843, but never proved of much value to the public until brought into use several years ago as a railway tunnel.

As the result of the deadlock at Washington, the appropriation failing to come to time, all the lake survey parties sent out this spring from Detroit, Mich., have been ordered home.

American Institute of Architects.

OFFICE 128 BROADWAY (Cor. Cedar St.)
New York, May 27th, 1876.

DEAR SIR,—The 10th Annual Convention of this Institute will be held in Philadelphia, and will open on Wednesday, October 11th. Particulars will be duly forwarded.

The American Society of Civil Engineers have invited the professional members of this Institute to take part in the proceedings of their 8th Annual Convention, which will take place in Philadelphia, June 13th, 14th and 15th next. They request me to advise them as to those of our members who may propose to accept the invitation.

The same Society invite our members to make use of their rooms and appliances—situated in the upper part of the west end of their building—during the continuance of the Centennial Exhibition.

The Board of Trustees has passed a vote of thanks to the Society for their kind offers.

Yours respectfully,
A. J. BLOOR, Secretary.

HENRY L. GAY, Secretary Chicago Chapter American Institute of Architects.

Engineers' Club of St. Louis.

A meeting of the Club called by the President was held on June 10th at the office of the Meier Iron Co.

The meeting was called to order by the President and the minutes of last meeting read and approved. The Secretary reported progress in the matter of preparing Mr. Mill's paper on "Hot Blast Stoves" for publication, and also called attention to Mr. Pfeifer's paper on "Arch Bridges" in June No. of Van Nostrand's *Engineering*; after comments upon the peculiar style of the Greek letters used in this article the Club unanimously elected Mr. Julius Moulton and Dr. G. K. Klupfel as members of the Club.

The Secretary then read from the May No. of the *Journal of the Franklin Institute* an article by Mr. Wm. D. Marks, of the Lehigh University, and member of the Club, upon a new form of Engine Governor, of his invention. After discussion of this invention, attention was directed to the pumping engine of the Lowell Water Works, built under direction of Joseph P. Davis, formerly treasurer of the Club.

The Club then listened to a paper by Mr. E. D. Meier upon "Coal Washing in Illinois." This paper was illustrated by photographs and by specimens of the coal in the various stages of the process. After discussion by the members, the Club adjourned. One gentlemen was proposed as a member.

Annual Meeting of the American Society of Civil Engineers.

The Eighth Annual Convention of the American Society of Civil Engineers commenced on Tuesday the 13, in the judges' pavilion, Centennial grounds. It was called to order by the President, Geo. S. Greene, after which an address was delivered by Theodore G. Ellis, first Vice President, retrospective of the progress of civil engineering for the past one hundred years, at the conclusion of which Thos. C. Clarke, of the Phœnixville Iron Works, was chosen permanent Chairman of the meeting.

After a debate on the paper entitled "The Theory of Continuous Girders in relation to Economy in Bridge Building," read before the Society in May, 1875, by Chas. Bender, C. E., and which was participated in by Clemens Herschel, C. E., Prof E. C. Dubois, and others, the subject was postponed until Thursday, and Mr. Henry Pettit was called upon to read a paper on the design and erection of the Exposition buildings. The history of the enterprise was first referred to by Mr. Pettit who then gave the reasons, etc., for the change of the design of the main exhibition building from that first planned. He then entered into an exhaustive review of the whole subject, from the adoption of the plans to the completion of the building, showing the rapid progress made in its erection, Among other interesting data mentioned was that the mass of iron in the building amounted to 8,348,000 pounds, and the various kinds of straight and T iron, etc., would reach a distance of 141 miles, while if all the iron was made into a solid piece it would measure 25 feet 10¼ inches per side. The remainder of the session was occupied by Mr. Herman Schwarzmann in giving a description of Memorial hall and the Horticultural building.

The Centennial Judges.

One hundred and twenty-five American judges have been appointed by the Centennial Commission. The list of one hundred foreign judges to be added to them is not yet complete. The committees of most interest to the readers of the NEWS are:

Minerals, Mining and Metallurgy:—A. L. Holley, of N. Y.; T. Sterry Hunt, of Mass.; J. M. Safford, of Tenn.; S, J. Reeves, of Penn.; S. B. Axtell, of New Mexico; Mathew Addy, of Ohio; J. D. Hague, of Cal.; W. S. Keyes, of Nevada; Fred Prime, Jr.

Pottery, Glass, Artificial Stones, &c.:—Gen. Q. A. Gillmore, U. S. A.; Arthur Beckwith, of N. Y.; E. T. Cox, of Indiana; Hector Tyndal, of Penn.; C. M. Chaffiet, of S. C.

Apparatus of Heating, Lighting, Water Supply and Drainage:—C. C. Cox, of Washington; Dr. Azel Ames, of Mass.

Railway Plans, Rolling Stock and Apparatus, Road Engines, &c.:—R. E. Ricker, of N. J.; Gen. Morris, of Indiana; Felicien Satalafer, of Penn.

Vessels and Apparatus of Transportation:—Isaac Newton, of N. Y.; J. W. Griffiths, of N. H.

Motors, Hydraulic and Pneumatic Apparatus, &c.:—Chas. F. Porter, of N. J.; Joseph Belknap, of N. Y.; J. F. Holloway, of Ohio; Jas. Moore, of Penn.; Horatio Allen, of N. J.

Machine Tools, Wood, Metal and Stone:—Irving M. Scott, of Cal.; G. H. Blelock, of Mass.; W. F, Burfees, of Wis.; J. A. Anderson, of Ky.

Instruments of Precision, Research, Experiment and Illustration, including Telegraphy and Music:—Prof. F. A. P. Barnard, of N. Y.; J. E. Hilgard, of U. S. Coast Survey; H. K. Oliver, of Mass.; Geo. F. Bristow, of N. Y.; Prof. Watson, of Mich,

Architecture and Engineering:—James B. Eads, of St. Louis; Gen. W. B. Franklin, of Conn.; Richard M. Hunt, of R. I.

The New Water Works at Marshalltown, Ia.

The proposals for the construction of the new water works at Marshalltown, Iowa, were opened on the 10th inst. There were over forty bids received, only three of which were for the entire work, as follows:

S. D. Carpenter & Co., of Ottumwa, Iowa, $46,500; T. B. Farrington, of Chicago, $47,900, and Geo. C. Morgan, of Chicago, $49,470. The remainder were for separate portions of the work. The contract was awarded by the City Council, on the 12th inst., to S. D. Carpenter & Co., on their bid of $46,500 for the entire works, with mains and pipes complete and ready for use. The contract stipulates that the Chapman fire hydrants and stop valves shall be put in, and that the pumps used shall be the "Knowles direct acting double plunger." These are to be of a 24-inch diameter steam cylinder, and 12-inch diameter water cylinder, with two feet stroke. The cast iron pipe will be furnished by Dennis Long & Co., of Louisville, Ky. The Marshalltown *Daily Times* says:

"The mains are to be laid six feet under the surface of the ground and the entire work to be in operation before cold weather sets in.

"The water will be taken from about the middle of the Iowa River, below the dam and conducted by a cast iron pipe of sixteen inches in diameter to the filter bed, just at the water edge, where it will be filtered from its impurities and from where it will be drawn by the suction pipes of the pumping engines. These engines will consist of a pair of direct acting pumps and engines, capable of pumping two million gallons per 24 hours or of throwing six effective fire streams. They will be fed with steam from two boilers about four feet in diameter by fourteen feet long, and with a capacity of 150 horse power. The house to contain the boilers and machinery will be a plain fire proof structure about 50 x 30 with a chimney 75 feet high. There will be fifty fire plugs capable of supplying two lines of hose each. One will be placed on each street corner where the lines of pipe are located and some additional ones in the more thickly settled business and manufacturing portion of the town. Thus the whole thickly settled portion of the town will come within reach of the fire hose and will be efficiently protected from the devouring element."

The City Council has passed an ordinance bonding the city to the amount of $47.000 and engaged the services of T. N. Bontelle, C. E., to superintend the construction of the work, which will be commenced at once.

The Scioto Valley Road from Chillicothe to Columbus, O., has just been completed.

Iron Castings.

CONCLUDED.

Castings for Building Purposes consist usually of foot plates for columns, sill courses, with or without panels, for illuminated tile, the plates for the tile of the various forms used, columns for the interor and exterior lintels, box, tee, or skewback cornices, window sills and caps, spandrel fillings and the various pieces for ornamentation which are often cast separately and attached afterwards, crest railings, stairways, both straight and circular, and girders both straight and arched.

Foot plates are used to support other work on the top of masonry, and for columns are usually rectangular or square, from 1 to 4 inches thick in the center bevelled off from ½ to 1½ inches at the edges. A boss or cross is sometimes raised in the center, and the plate faced down in a lathe outside of this projection for a bearing for the column. If there be no projection, the upper surface may be planed instead of faced in a lathe. These plates are usually set in cement, but if the top of the stone work be sufficiently well dressed, (bush-hammered) a sheet of lead is a better, though more costly bearing. Great care should be exercised in setting the plates for columns truly level, and a very common practice of trueing up columns by the interposition of thin pieces of sheet iron between the plate and column known as "shimming" should not be tolerated.

Plates for girders are usually rectangular, with the greater length placed along the wall and at right angles to the girder. Their size is to be proportioned to the load carried, and the object of such plates is to distribute the load, and to prevent too great a concentration upon any one portion of the masonry, and the true surface and bearing is only to be obtained by a certain amount of rigidity obtained by thickness of the plates. As an illustration of the range of practice we will instance two examples as extremes. The plates under the ends of a 96′ truss rafter were 36″ × 18″ and 3″ thick at the center. The trusses were about 17 feet apart. This may be considered as the extreme of caution. The other case is also a roof, the span of which is 92′ the trusses being about 15′ apart. The plates are 12″ × 10″ of wrought iron three-sixteenths inches in thickness. This is the extreme of risk, and between the cases is a very wide variation. The casting of plates presents little difficulty and only requires ordinary care.

Sill courses are usually made in lengths of from 8 to 20 feet, with one vertical face or riser on the front, and a horizontal tread from 15 to 36 inches, and if broad a vertical web or stiffening flange at the back with a depth depending on the distance between the supports, of a thickness from ¼ to ¾″. The supports are stone piers, a stone wall, or iron basement columns. If there be a continuous wall no flange at the back of the sill will be necessary. Where the sill carries the columns of the first floor it must have a direct support and should be planed on the upper surface at the column bearing and should be carefully set level. These sills are often cast with open spaces, in which is placed a panel of illuminating tile, often on the riser and sometimes on both riser and tread. If the sill is carried on stone piers, it is to be carefully set and flushed with cement to secure a good bearing.

When iron columns are used in the basement the best plan is to carry the column through the sill and to support the latter by brackets cast on the column and faced; the bearing of the sill on the bracket should also be faced. Sills are often very troublesome castings to make as the metal is often very unevenly distributed. At the junction of riser and tread there is usually a projection, (an ornamental moulding) and moulded panels And as the metal is cooling the shrinkage will often pull a sill all out of shape, and will sometimes destroy it entirely. It is a common practice to strip the sand from the edge in order to cool it first; this in a measure will help, but good judgment in the matter is very necessary.

Illuminating tile is of various kinds but consists always of an iron plate studded with projections, and with apertures between them, in which are set thick pieces of common glass. The glasses are set in a cement, and are of various forms—circular, about 1½ inches diameter being the most common; hexagons of about 4 inches side are used, and smaller ones. The best kind is Hyatt's Patent "Lead Band" in which the glasses are circular and set in the iron with a leaden cast thimble which is calked tight. They are more expensive than the other kinds but they never leak or get loose when properly made and are decidedly superior in every way to the others.

The casting of a plate say 3′ 6″ wide and 7 or 8 ft. long, perforated with small holes 1¾″ diameter close to each other, and ¾″ thick is always troublesome, as there is such a number of small portions to be looked after, and there is, moreover, a very strong tendency to warp. A smooth, perfectly true iron pattern is the only thing which can be used with any thing like good results, and even then a good many pieces will be found in the scrap pile. These panels are set in the recesses in the sills prepared for them, or are carried in cast frames on the sidewalk beams when used outside.

For inside floor lights thick plates of glass 1″ to 2″ are more often used, with a width of from 19 to 24 inches, and set in iron frames of cast or wrought iron.

Iron columns are made either cylindrical or rectangular, and sometimes are left with an opening along one side to be filled with brick work. Columns are usually cast on the side in green sand, with dry sand cores, which must be carefully made and properly vented; the core must be rigid, and is usually prevented from springing by the use of the "chaplets" or "anchors" whose use has already been mentioned. To illustrate the necessity of chaplets it may be mentioned that for a 12″ column 1″ thick and 18′ long, the springing upward of a solid cast iron core bar, 8″ diameter is, under the weight of iron with only 12″ head, exactly ⅓″ which would result in a column ⅝″ thick on one side and 1⅜″ thick on the other, and if there is 24″ head of liquid metal, the column would be ⅜″ thick on onr side, and one and five-eighths inches thick on the other. Some engineers never understand that nothing but direct support will give any approach to rigidity, and condemn the use of chaplets in columns, when the evils introduced by their absence would be far worse than those caused by their presence. The iron must be hot to unite solidly around the chaplet.

In architectural work, for the sake of appearance, much larger columns are usually employed than those needed to carry the actual loads, and it is only rarely necessary to consult the many good tables for the strength of columns. The best table in use is that of James B. Francis, Esq., the eminent engineer, of Lowell, Mass. Large columns at the corners of buildings are commonly square, and if the panelling is to be thin it will be advisable to make the column in vertical sections and bolt them together by flanges, as the shrinkage very often renders them unsafe, and they have even broken when in the mould after they have been stripped.

Box lintels are used to carry walls over the openings in lower stories. They usually consist of a broad bottom flange with two or more upright tiles, and their strength is computed as for a Tee beam.

Cornices are usually cast separately, and as thin as they can be made and are secured to the lintels by small screws.

Skew back lintels are Tee shaped girders with one or more vertical webs, with end plates, between which a brick arch is turned, and the idea has been that they only acted as tension rods to carry the thrust of the arch, but in reality any settling of the arch leaves the weight resting on the girder and their strength should be found as for a tee beam. Hodgkinson's double tee beams and arch and tension rod girders are used, and in our opinion the latter have all the bad features which Sir Wm. Fairbairn finds in trussed cast iron beams. (See "Researches on the application of Iron to Buildings.") When a Tee or Hodgkinson beam is not strong enough, wrought iron should always be used.

The small ornamental work presents little difficulty and it is only when combined with large and irregular sections that trouble will be found.

Cast iron stairs present all the troubles found in sills, and if made in one flight the multiplication of small changes of form often renders the fitting into place a work of great labor—a flight of seven steps sometimes varying 2″ from the length of the pattern (measured on the slope). Circular stairs are made in single steps, one tread and one riser, and are fitted over a wrought iron center post, from 2″ to 4″ in diameter. Railings for them are made from a curved pattern, and the work is apt to cost more than the founder expects it to.

This brief sketch has only been given with the hope of in some way interesting engineers and architects in the work of the founder, and is known to be very far from complete; but if only one reader is found who will study a little the work in the shop, the object of these few pages will have been reached. S.

Contractors' Intelligence.

The excavation for the new court house at Peoria has proceeded so far that the work of laying concrete for the foundation has been commenced.

The bridge recently awarded to the Massillon Iron Bridge Co., to be built over the Shenango River at Greenville, Pa., was to replace a King Arch bridge.

Work on the Adams County, Ill., court house is progressing rapidly. The basement is nearly ready for the dressed stone, and the contractor expects to have the building under roof this fall.

The Cincinnati Southern Railroad Directors have awarded contracts for seventy-four miles of the road, from Emory Gap to Chattanooga, Tenn., at an average of less than $10,000 per mile.

J. H. Burnham, agent of the King Iron Bridge Co. of Cleveland, Ohio, has recently closed a contract with the town of Roscoe, Winnebago, Co., Ills., for a tubular arch bridge to replace a Truesdell iron bridge which fell a few weeks ago.

The contract for building the bridge over the South Branch of Tunkhannock Creek in Scott Township, Luzerne Co., Pa., was awarded last week to the Wrought Iron Bridge Co. of Canton, Ohio, at $12.45 per foot and $100 for the abutments, making a total of $672.10. The bridge will be forty-six feet long,

A species of red sandstone recently discovered in a quarry some twenty miles west of Appleton, Wis., on the line of the Wisconsin Central Railroad, is being used for building purposes at Appleton. It is said to be equal in appearance and quality to the justly celebrated Lake Superior sandstone, is easy to work, and hardens quickly. It will be put upon the market at once by the Appleton Brown & White Sandstone Company.

The Canadian Government is soliciting bids for the construction of sections of the Pacific Railway between Lake Superior and the Pacific Ocean, contractors to receive lands or proceeds of lands at the rate of 20,000 acres, and cash at the rate of $10,000 per mile, together with interest at the rate of 4 per cent. per annum for twenty-five years from the completion of the work, or any further sum which may be stipulated in contract.

The Government works on the Lower Fox River in Wisconsin, comprising a stone lock at Appleton, and one large combined lock at Little Chute; also two stone locks at Kaukauna in connection with five dams located at Cedars, Little Chute, Kaukauna, Rapid Croche and Little Kaukauna are in active progress. Colonel Fuller is the Assistant Engineer in charge, and a portion of the work is being done by hired Government employes, and the balance by McArthur Bros., of Chicago, who are building all the locks except the one at Appleton, These locks will cost from $30,000 to $40,000 each, and the dams from $10,000 to $20,000.—*Chicago Tribune.*

PROPOSALS FOR CONTRACTS.

BRIDGE WORK.—Bids will be received at the office of the Commissioners of Hamilton Co., O., in Cincinnati, until Saturday, July 1st at 12 M., for masonry, excavation and superstructure for a bridge across Symmes Creek, on the road from Symmes to the Sixteen-mile Stand, Symmes township. Specifications can be seen at this office. Jos. B. Humphreys, Auditor,

BRIDGE WORK—Proposals will be received at the office of the County Commissioners of Hamilton Co., O., in Cincinnati, until 12 M., July 1st for making the approaches to three bridges in Sycamore Township: 1st, Over the Miami Canal, on the road from Glenwoad to South Glendale; 2d, Over the Miami Canal, on the road from Glendale to Sharon; 3d, Over the West Branch of the East Fork of Millcreek, on the road from Glendale to Sharon. Specifications can be seen at this office. Jos. B. Humphreys, Auditor.

BRIDGE—Proposals will be received at the Auditor's office, Batavia, Ohio, until 12 M, June 28th, for the superstructure of the following bridges: Two spans 120 ft. each across East Fork Little Miami, near East Liberty; One span 165 ft. across same stream near Batavia; One span 130 ft. across Stone Lick, near the Catholic Church. Bidders will furnish their own plans and specifications. C. J. Harrison, Auditor.

BRIDGE ABUTMENT, ETC.—Proposals will be received at the City Surveyor's office, Room 9, until 7½ P. M., June 22d, for furnishing all materials and building the abutment and retaining walls on the New Haven side of the bridge over West River, at the Congress Avenue crossing. Blank forms of proposals, with the necessary bond attached, can be obtained, and any information concerning plans, specifications, etc. will be furnished upon application. Charles E. Fowler, City Surveyor.

BRICK LAYING—Proposals will be received at the Commissioners' office in Warrenborough, Pa., until 12 M. June 24th for laying brick in the court house at Warren. Proposals must state the price per thousand for laying the brick and furnishing the mortar. Also, must state the number of brick per square foot, of each thickness of wall required to be built, and the mode of measurement of the walls. All work to be done with the approval of the superintendent, and no pay for extra work of any kind will be allowed. Plans and specifications, giving full information in reference thereto, can be seen at the Commissioner's office. R. K. Russell, Clerk.

BRIDGE—Bids will be received at the office of the Commissioners of Hamilton Co., O., in Cincinnati, until July 1st at 12 M. for masonry of the abutments of a bridge across Millcreek, on the road from Hartwell to Lockland, in Sycamore township. Specifications can be seen at this office. Also, for an iron superstructure at the same place, clear span 80 ft.; clear roadway, 18 ft. Bidders will furnish their own plans and specifications therefor. A full and complete strain sheet to accompany each plan. Said bridge must be of sufficient strength to sustain 100 pounds per square foot of floor surface beside its own weight; factor of safety 4 15,000 tension, 12,500 compresson. Payments will be made in Hamilton Co. bonds, bearing interest at 7 per cent, By order of Commissioners. Joseph B Humphreys, Auditor.

BRIDGE—Proposals will be received by the Commissioners of Portage Co., Ohio, at their office in Ravenna, Ohio, up to 12 M July 1st, for the construction of a triple arch stone bridge over the Cuyahoga river on Main St., in the village of Kent, in Portage Co. Proposals will be for the entire masonry complete, in accordance with plans and specifications; proposals by the perch will not be considered. Plans and specifications for the above work will be on file in the County Auditor's office. Two piers and one abutment in this job is to be built to Spring Line, under the present bridge now standing, on or before November 1st 1876 and the entire work to be completed on or before September 1st 1877. Wm. Grinnell, Co. Auditor.

COURT HOUSE REPAIRS—Bids, with names of securities will be received at the office of the Co. Clerk, of Randolph County, Mo., until 12 M., June 26th, for extensive repairs on the court house at Huntsville. Plans and specifications to be seen at the above office at Huntsville, and at the office of C. B. Clark, architect, 719 Locust St. St. Louis. Payments made as the work progresses. By order of the County Court. Chas. Allin, County Clerk.

COUNTY PRISON EXTENSION—Proposals will be received by the Commissioners of Schuykill County, at their office, in the county court house, Pottsville, Pa., until 4 P. M., June 28th, for the roofing, plumbing and gas fitting, plastering, painting and glazing required for the extension of the Schuykill County Prison. Each of said proposals to be indorsed separately as above enumerated. Plans and specifications of the work may be seen at the Commissioners' office until June 24th. Morgan W. Fehr, Louis Blass, Patrick Collins, Commissioners. E. A. Schartel, Clerk.

CHURCH—Proposals will be received by the undersigned for furnishing the materials and erecting the Swedish Evangelical Luthern Church of Moline, Ill. Dimensions, 116x62 feet, exclusive of buttresses. Basement story 12 ft., principal story 28 ft. aisles and 46 ft. nave; built of brick and trimmed with stone. The plans and specifications can be seen at the studio of Rev. A. G. Setterdahl, Moline, Ill. until 12 M. June 26th; after that at the office of L. N. Holmes, architect, Room 23, Mitchell & Lynde's block, Rock Island, until 12 M. July 12th. Bids will be received for the whole job complete, or for the brick and stone work and carpenter work, separately; the carpenter to bid with and without the spire above brickwork. A. G. Setterdahl, Chairman of Building Committee.

DREDGING—Proposals for the excavation and removal of about 500,000 cubic yards of material from the inner harbor and the Main Branch of the Patapsco will be received at the office of the Harbor Board of Baltimore, until noon, June 21st, and opened at 12:30 P. M. same date. No proposal will be entertained for less than 150,000 cubic yards. Specifications and any other desired information can be obtained on application at the office of the Board, City Hall, Baltimore, Md. N. H. Hutton, Engineer.

GLASS PLATE—Proposals will be received by the Board of Commissioners of Marion Co., Ind., until June 24th at 2 P. M., for all the glass for the new Marion Co. court house. Specifications, dimensions and form of proposals can be seen at the office of the Architect. No. 6 Griffith's Block. I. Hodgson, Architect.

LAYING GAS PIPE—Proposals will be received at the Wheeling, (W. V.) city gas office until July 3d, for laying an 8 inch gas pipe, with drip boxes and pump, across the Ohio river opposite 21st Street, in said city. All bidders to furnish their own specifications and name the price at which they will do to the satisfaction of the Superintendent of Gas Works and the Trustees. J. L. Maxwell, Secretary.

MASON WORK.—Bids will be received at the office of the Clerk of the Board of Education of Cleveland, Ohio. until 12 M., Monday June 26th for the mason work on the Mayflower School addition. Plans and specifications may be seen and blank proposals obtained at the Clerk's office on and after June 12th. The bid for labor and materials must each be separately stated with the price thereof. No proposal will be entertained unless made on the blanks furnished by the Board. F. M. Sanderson, Chairman Building Com.

ROOFING SLATE—Proposals will be received at the office of the Kansas State Penitentiary in Leavenworth, Kansas, and opened at 2 P. M., July 6th, for about 75 squares of roofing slate, punched for nails, and sufficient nails to put the same on, and delivered on the cars at Penitentiary Switch. It is not necessary to be even in color, but of good quality for shop roots. Henry Hopkins, Warden.

RESERVOIR—Bids will be received at the office of the Board of Fire Commissioners of Clevelend, O, until 12 M. June 22d for the construction of a reservoir at or near the corner of Herald and Rolland Sts., 15th Ward. Said reservoir must be of sufficient capacity to contain not less than 500 barrels to the spring of the arch and built in accordance with the plans and specifications now on file in this office. Bidders will give price per barrel. A. J. Spencer, Secretary.

SCHOOL HOUSE—Proposals will be received by the undersigned till June 26th, at 3 P. M., for the erection of a school building including material, in the village of Eyota, Minnesota. Each proposal must be for the entire completion of the building and outhouses. Full plans and specifications can be seen at the office of C. G. Maybury, Winona, or at the store of Dyar & Ingam, Eyota. J. W. Bliss, G. G. Barto, E. D. Dyar, Committee.

SCHOOL HOUSE—Bids will be received by the School Board of Washburn, Ill., until July 1st, at 12 M. for the erection of a brick school house in accordance with the plans and specifications on file in the office of W. J. Edbrooks, 179 E. Madison, St., Chicago; each bid must be accompanied by a bond of the usual form, in the penal sum of $200. Address proposals to S. W. McCulloch, Wrshburn, Ill., indorsed "Proposals for Building a School Building." S. W. McCulloch, Secretary.

ST. ANTHONY'S FALLS IMPROVEMENT—Bids in duplicate will be received by the undersigned, at the U. S. Engineer's office, in St. Paul, Minn., until 12 o'clock, noon, June 29, 1876, for the following work at the Falls of St. Anthony, Minneapolis, Minn. 1. Furnishing the materials and constructing two dams on limestone ledge. 2. Filling a portion of the old tunnel and other passages under the lime rock above the dyke. For all information apply to F. U. Farquhar, Major of Engineers.

SCHOOL HOUSE—Proposals will be received by the undersigned for building a brick school house, in Washington, Ill., until June 25th. The building is to be 74x86 feet, two stories and basement. Plans and specifications may be seen at Ben Toblas' office, in Washington. D. S. Sheppard, Secretary.

STREET IMPROVEMENTS—Proposals will be received at the office of the Board of Public Works of Cincinnati, O., until 12 M. July 10th for grading. curbing. flagging gutters, macadamizing the road bed and constructing the necessary culverts. drains or retaining walls, in accordance with specifications on file in the office of the Board of Public Works, Locust Street from Mount Street to Mason Street. John E. Bell, President.

STEAM HEATING APPARATUS—The Committee on the Public Library of Detroit, Mich., having rejected bids heretofore received for heating the new library building, again invite sealed proposals for furnishing all material and putting a low pressure steam heating apparatus in the new library building. Bids will be received at the office of the Chairman of the Committee on Public Library, over First National Bank, Detroit until June 20th, at 12 M. Information as to the work required can be had of George Morhous, Superintendent. Committee on Public Library.

SCHOOL HOUSE—Proposals will be received at the office of the Clerk of the Board of Education of Norwalk township, Huron Co., O., until 12 M., June 24th for building a brick school house on the lot situated in sub-district No. 2 of said township, according to the plans and specifications on file in said office. The bid for each kind of material called for by the specifications must be stated separately, and the price of each must be separately stated. By order of the Board of Education. H. L. Kennan, Clerk, No. 4, St. Charles Block, Norwalk, O.

STATE BUILDING—Proposals for furnishing all materials and the erection of a fish state hatching house, and also a tenement house, to be erected at the Nine Springs, in Fitchburg three miles southwest of West Madison depot, according to plans and specifications thereof, will be received by the Fish Commissioners of Wisconsin, at the law office of Welch & Botkin, 23 Pinckney Street, city of Madison, where plans and specifications can be seen, 12 M., Monday, June 26th. Separate proposals will be received for the two buildings to be erected. Fish Commissioners.

STREET IMPROVEMENT—Bids will be received at the office of the Board of Improvements of Cleveland, O., until 12 M. June 23d, to furnish and lay stone flagging for sidewalks for the ensuing year. The city is to be divided into three or more districts and proposals will be received for each district separately. Sealed proposals will also be received at the above mentioned time and place for furnishing any laying crosswalk stone at street crossings for the ensuing year. Also, proposals will be received separately for furnishing and laying. And, proposals for cross-walks will be received for the East and West Side separately. Specifications and blank proposals can be obtained at the office of the City Civil Engineer. By order of the Board. M, G. Watterson, Clerk.

STEAM HEATING APPARATUS—Proposals will be received until July 10th at 12 M., for a steam heating apparat for the Buffalo State Insane Asylum. Proposals may be in accordance with two plans and specifications, or either of them, marked No. 1 and 2 respectively, now in the posession of the Board of Managers; or any party may submit other plans and specifications with their proposals. Proposals will be received for the entire work complete, or for the boilers, engines, fans, piping, radiators, or for any portion of the work herein enumerated separately. Plans and specifications can be seen and further information obtained at the office No. 31 City and County Hall. Proposals will be addressed to Wm. F. Rogers, Secretary, No. 31 City and County Hall, Buffalo, N. Y. James P. White, President Board of Managers.

STATE ROAD—In pursuance of Act 177 of 1859, and Acts amendatory and supplementary thereto, the undersigned, Commissioner of the Presque Isle & Little Traverse State Road will receive proposals in writing for the construction of that portion of said road as follows: Commencing at the point near Little Traverse Bay, at the intersection of the east line of the northwest quarter of northwest quarter of section 6, town 34 north, of range 5 west, with state road, and running thence easterly on surveyed line of said road to the southeast corner of section 6, town 34 north, of range 3 east, being a distance of 45 miles and 35 chains. Contracts will only be made with responsible parties who will be required to furnish two acceptable sureties as a satisfactory guarantee that the parties proposing will enter into contract as required, and complete the work in good, workmanlike manner by Dec. 1st, 1877. Proposals will be received at my office in the village of Petoskey City, Mich., until 4 P. M., July 10th, at which place the survey of said road and form of contract required may be seen, and such other information obtained as may be desired. Payments for the work will be made by the state in any vacant state swamp lands in the Lower Peninusula at the minimum price established by law. John Keep, Local Commissioner.

TOWN BUILDING—Proposals will be received by the Clerk of the incorporated village of Harrison, Hamilton Co., O, until 12 M., Thursday, June 22d, for the erection of a new town hall building. It will be understood by each bidder that a reserve of 15 per cent will be held until the building is completed and accepted by the Superintending Architect and Building Committee. Work to commence immediately after the letting. For plans and specifications call on the undersigned, Town Clerk, Harrison, Ohio, or on Parsons & Co., architects, Indianapolis, Indiana. By order of the Council. J, F. McManaman, Town Clerk.

WATER PIPE—Proposals will be received until noon of June 20th, at my office, 131 LaSalle St., Chicago, for furnishing the village of Hyde Park 3,600 ft., more or less, of 6-in. cast iron water pipe, to be delivered at Hyde Park. Said pipe is to weigh 32 pounds per lineal foot; to be cast vertically in 12-ft. lengths; to be subjected to 300 pounds hydraulic pressure, hammer test, before leaving the foundry; and subject to the same test after delivery; and coated in the best manner according to the Dr. Smith process; and to be tested after being laid in the ground to 175 pounds hydraulic pressure. John R. Bensley, President of the Board.

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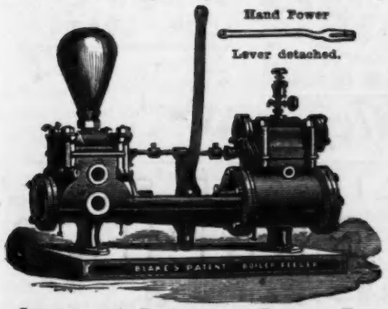

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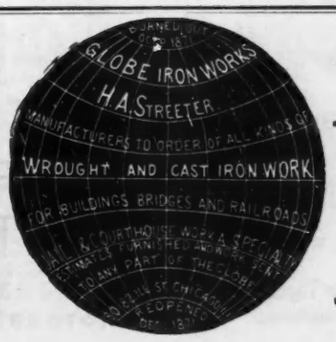
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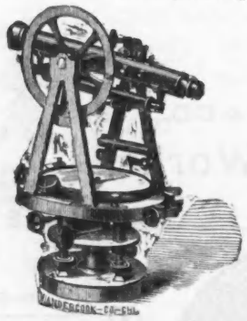

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